

Short- and Long-range-order Structures in $\text{TiO}_2\text{:Co}$ Room-temperature Ferromagnetic Semiconductors Studied by X-ray Absorption Fine Structure and X-ray Diffraction

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Variations of short- and long-range-order structures in $\text{TiO}_2\text{:Co}$ room-temperature ferromagnetic semiconductors due to thermal annealing have been investigated by using the x-ray absorption fine structure (XAFS) and x-ray diffraction (XRD) techniques. The samples were prepared by a sol-gel method and exhibit ferromagnetism at room temperatures. The XRD results show a three-stage transition of the long-range-order crystal structure from amorphous to a mixture of rutile and anatase phases and then to the pure rutile phase as the annealing temperature increases from 220°C to 1000°C . However, an anatase-like local structure around the Co dopant emerged at an annealing temperature of 450°C and remained stable up to a high annealing temperature of 1000°C when the crystal structure of the TiO_2 matrix changed from the as-made amorphous to pure rutile phase. The stable anatase-like local structure around the Co impurity atoms in the TiO_2 matrix of changing crystal structure and magnetic properties may reveal a novel mechanism for the observed ferromagnetism in $\text{TiO}_2\text{:Co}$ system, potentially useful for spintronic applications.

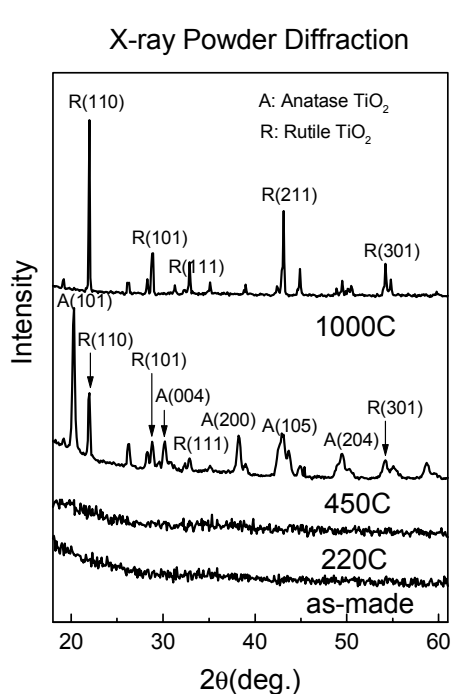


Figure1. XRD data for the $\text{TiO}_2\text{:Co}$ samples.

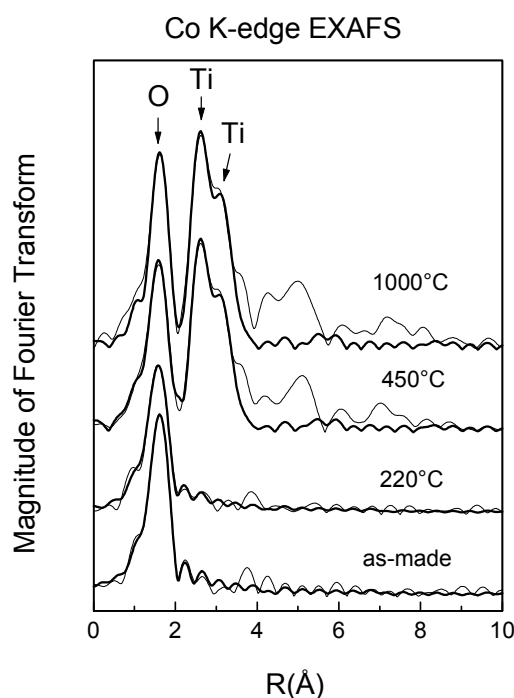


Figure2. EXAFS data for the $\text{TiO}_2\text{:Co}$ samples.

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